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Comparative analysis of multi storey building with Seismic Static and Dynamic (Response Spectrum) actions

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ABSTRACT

In an urban area, due to lack of spaces residential buildings and commercial buildings require large empty spaces for parking, auditorium halls, banquet halls and other commercial activities. To compensate this problem, High rise buildings got introduced. In this study, reinforced concrete G+9 building structure is studied with static and Dynamic (Response Spectrum) seismic actions for seismic analysis methods such as equivalent method and modal analysis method in Zone II using ETABS software. Analysis and design have been worked out using IS code Standard specification and national building regulations. After analysis it is observed that building with Dynamic (Response Spectrum) seismic actions shown safer results in terms of analysis and design parameters such as base shear, storey drift, storey displacements, moments and design compared to building without seismic actions.

OBJECTIVE:

The main objectives of the project are:

- To find out the seismic response of RC Building with Floating Column with respect to different seismic zones and on different storey of building.
- Prepare software model of G+12 Structure on ETABS software. Analyze the structure for Seismic loading and wind loading
- To find out the difference between Seismic parameters i.e. Base shear, Storey drift & displacement.
- To compare the performance results of RCC building with and without Floating Column.

METHODOLOGY:

- Prepare software models on ETABS Software.
- Analyse reinforced concrete building structure with static and dynamic analysis Equivalent and Response spectrum methods respectively.
- Analyse the above-mentioned models with seismic zones II.
- Compare the obtained analytical results from ETABS

MODELLING:

Model A – RC Building with G+9 with static equivalent analysis
Model B – RC Building with G+9 with dynamic Response spectrum analysis

FIG-1: ARCHITECTURAL PLAN

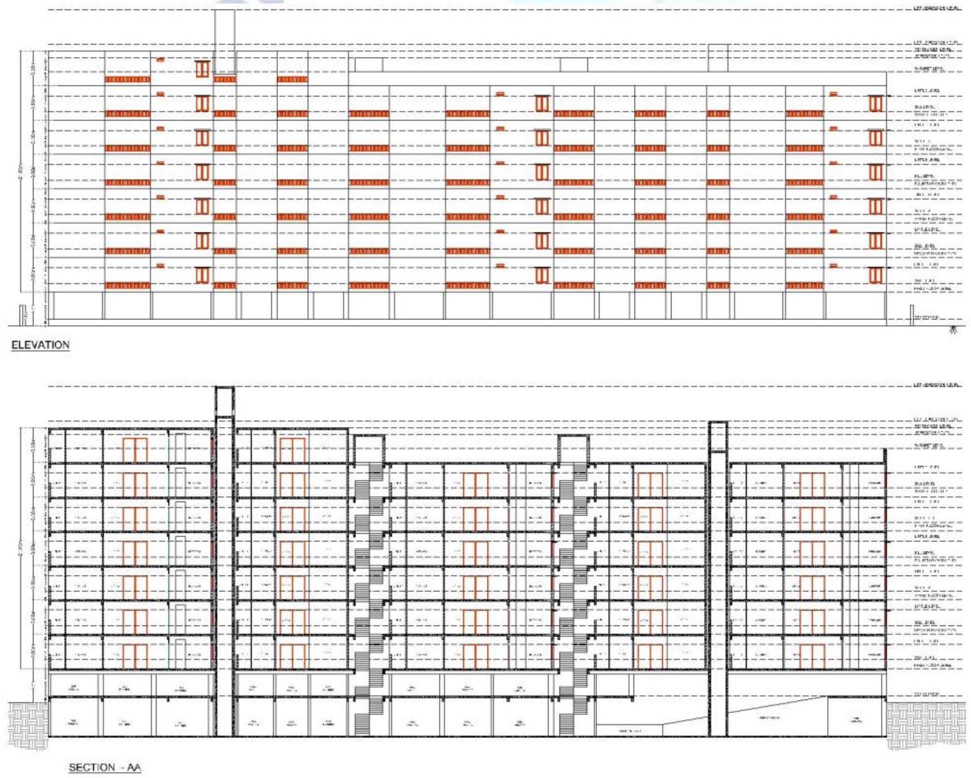


FIG-2: ARCHITECTURAL ELEVATION AND SECTION

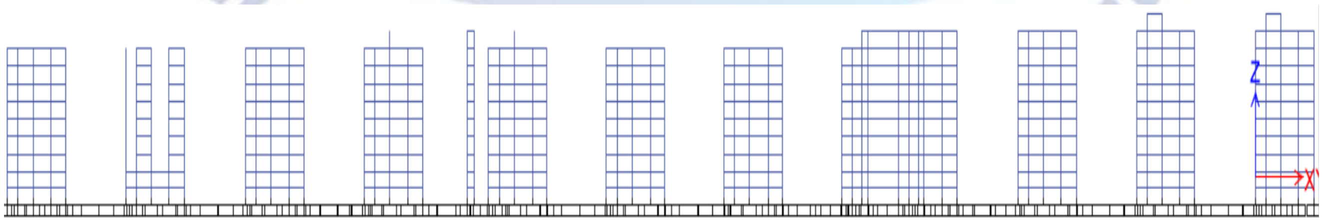


FIG-3: STRUCTURAL PLAN

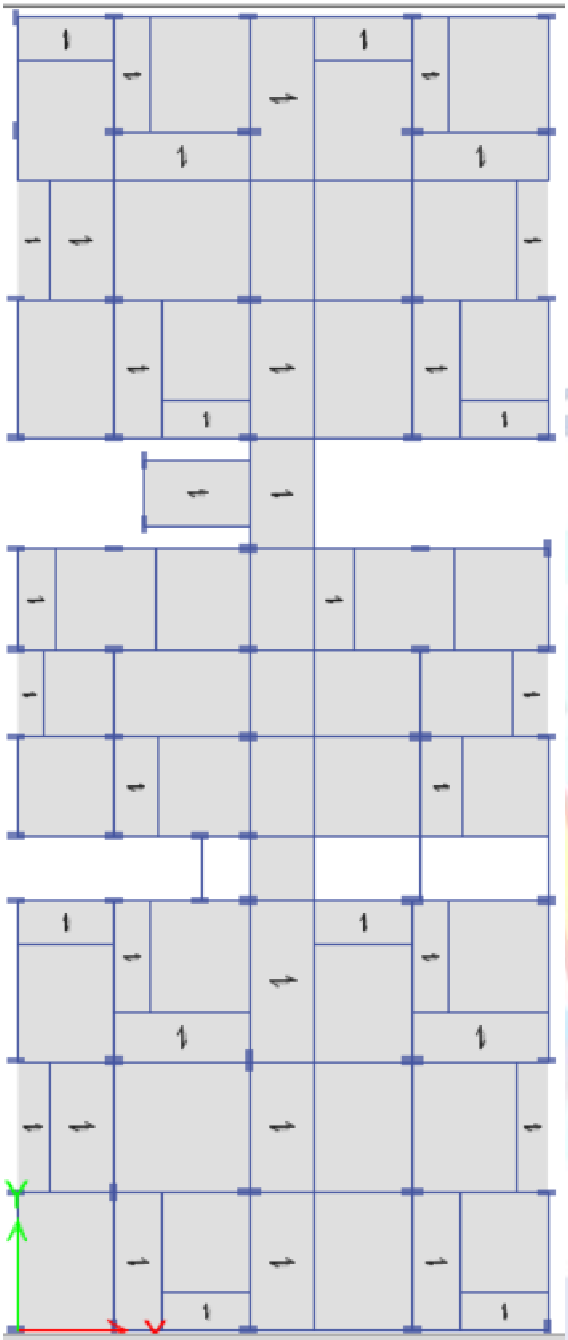


FIG-4: STRUCTURAL MODEL

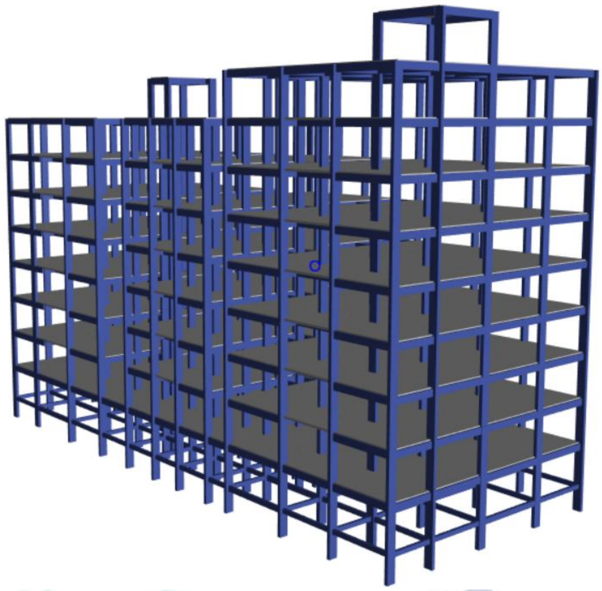


FIG-5: STRUCTURAL 3D VIEW

Load Cases:

- Dead Load (Self weight): 25 kN/³ as per **(IS-875:1987 Part-1)**
- Floor Finish: 1.5 kN/m² as per **(IS-875:1987 Part-1)**
- Live Load: 2 kN/m² as per **(IS-875:1987 Part-2)**
- Wind Loads as per **(IS-875:2015 Part-3)**
- Seismic Load as per **(IS-1893:2016 Part-1)**
  - Seismic Zone: II
  - Zone factor Z = 1
  - Importance factor I = 1.2

  Soil type = Medium-2

RESULTS:

Storey Shear: The diagram shows the value of lateral load acting per storey, it is always maximum at the base of building structure and it goes on decreasing at the top

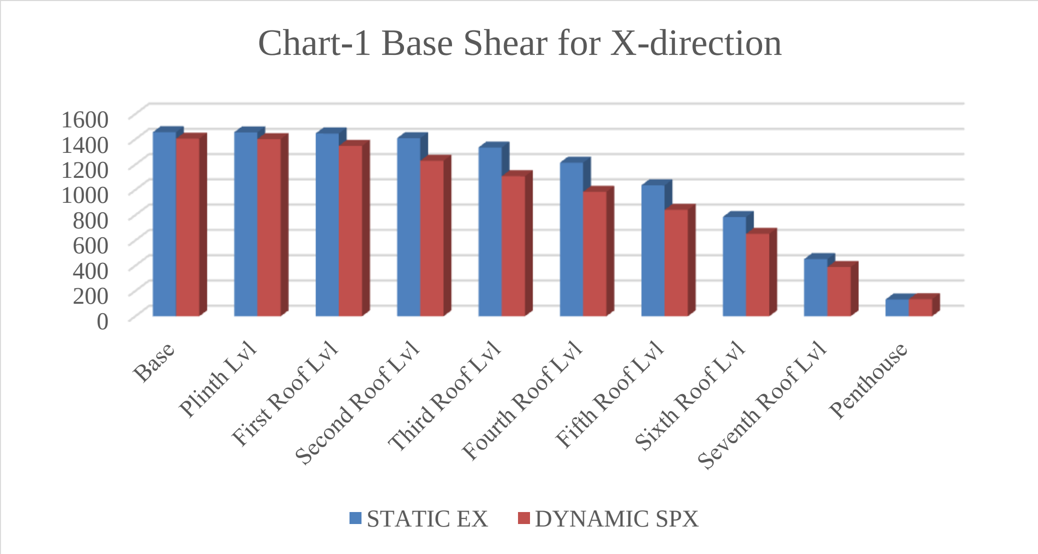


FIG-6: Base Shear Chart X-direction

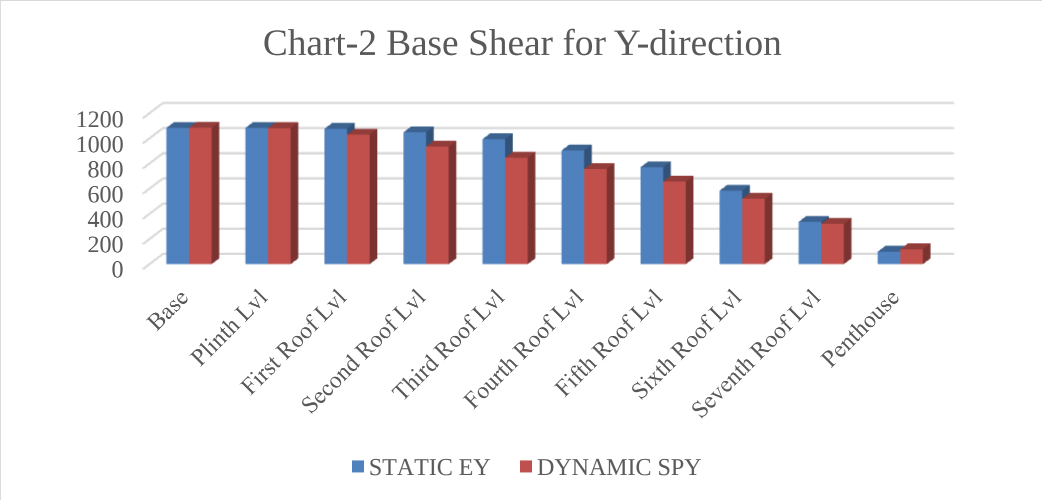


FIG-7: Base Shear Chart Y-direction

Base Shear	STATIC EX	DYNAMIC SPX
Base	1455.9	1404.65
Plinth Lvl	1455.4	1402.04
First Roof Lvl	1445.99	1348.107
Second Roof Lvl	1408.37	1230.2
Third Roof Lvl	1335.25	1107.66
Fourth Roof Lvl	1214.85	984.48
Fifth Roof Lvl	1035.44	841.56
Sixth Roof Lvl	785.19	651.93
Seventh Roof Lvl	452.33	389
Penthouse	133.01	135.49

Base Shear	STATIC EY	DYNAMIC SPY
Base	1083.14	1084.34
Plinth Lvl	1083.14	1081.64
First Roof Lvl	1076.14	1029.66
Second Roof Lvl	1048.14	934.81
Third Roof Lvl	993.72	845.97
Fourth Roof Lvl	904.12	756.88
Fifth Roof Lvl	770.602	656.43
Sixth Roof Lvl	584.35	520.07
Seventh Roof Lvl	336.63	320.82
Penthouse	98.99	118.46

FIG-7 & FIG-8: Base Shear values X and Y directions respectively

Variance in the Lateral Force

Lateral Displacement of the Structure along X - direction and Y-direction are mentioned below

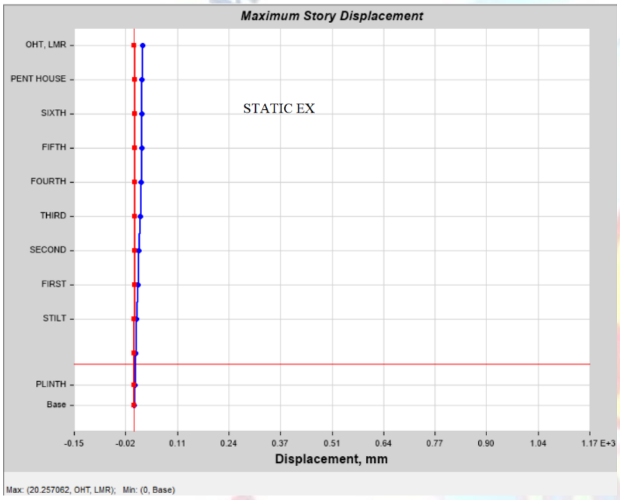
- X-direction
  - Static method – Ex = 20.25mm
  - Dynamic method – Spx = 25.89

The lateral displacement has increased 21.78% from static to dynamic analysis method

- Y-direction
  - Static method – Ex = 26.37mm

Dynamic method – Spx = 23.30mm

The lateral displacement has decreased 11.64% from static to dynamic analysis method



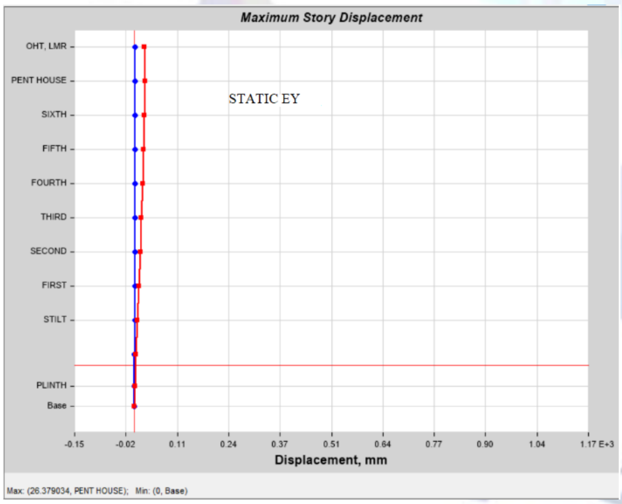
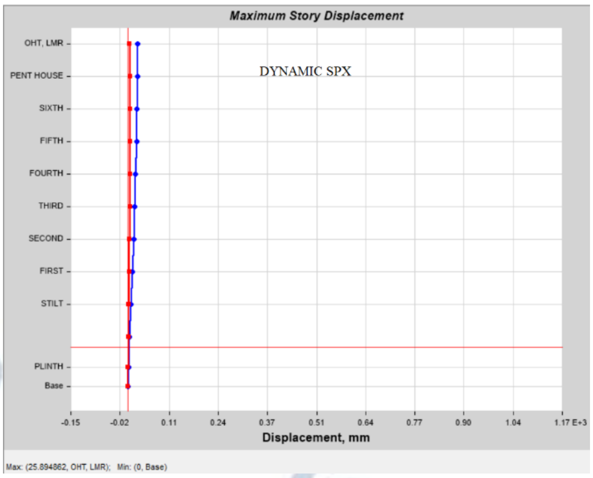


FIG-9 & FIG-10: Lateral displacement X and Y directions respectively



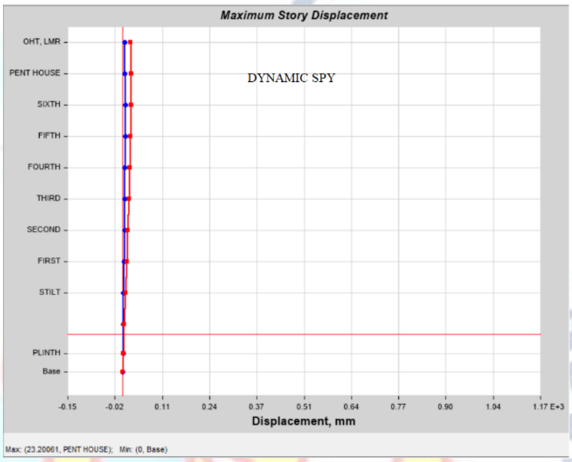


FIG-11 & FIG-12: Lateral displacement X and Y directions respectively

CONCLUSION:

- Building frame with dynamic analysis method gives better performance and shows greater values of seismic parameters such as base shear and storey displacement as compared to building static analysis method.
- Majorly dynamic analysis effects the model in shorter lateral direction.
- Lateral force has been increased 21.78% in X-direction from static to dynamic analysis.
- Lateral force has been decreased 11.64% in Y-direction from static to dynamic analysis, these results shows that dynamic analysis effects the model in shorter lateral direction.
- Base shear has been decreased 3.57% in X-direction from static to dynamic analysis.
- Base shear has been decreased 4.32% in Y-direction from static to dynamic analysis, these results shows that dynamic analysis weakens the building stability and need to provide more stability and stiffness to the building

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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